

OBSERVATIONS ON THE BIOLOGY OF LAND CRABS AND THEIR BURROW ASSOCIATES ON THE KENYA COAST

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ABSTRACT: Brief notes concerning the identification and burrowing habits of the two most common species of land crabs on the south Kenya Coast, *Cardisoma carnifex* and *Sesarma meinerti*, are given, as a result of observations made in the dry season of 1968. Records of two insect associates, the flies *Aedes pembaensis* (Culicidae) and *Psychoda martini* (Psychodidae), are reported along with pertinent data from a small collection of crabs of the above and others made in connection with the field studies.

INTRODUCTORY REMARKS AND ACKNOWLEDGMENT

Through the generosity of Dr. Purvis L. Martin of San Diego, California, sponsor of a general zoological expedition to Kenya, East Africa, January-March, 1968, Hogue had the opportunity to collect material and data pertaining to four species of burrowing land crabs and certain of their insect associates. A summary of the more significant field observations is presented to help fill the large gaps presently existing in the ecological knowledge of these animals. This report is one in a series evolving from our general study of tropical land crabs and their burrow associates (LCBA, see Hogue and Bright, 1969).

STUDY SITES

Observations were made and specimens taken at two stations near the town of Kilifi on the shores of the large bay (Kilifi Creek) flooding the mouth of the Voi River. A map and description of the general area is found in Moggridge (1950:301-304). The first station is on the south shore, immediately west of the ferry building (Figs. 1, 2, 3a). It is a gently sloping, coral sand beach, well overgrown with moderate-sized mangroves (*Rhizophora mucronata* and *Avicennia marina*), bounded shoreward by a banana grove. High steep cliffs close the beach on either side. The second station is situated on the north shore of Kilifi Creek, some two miles west of the ferry landing (Fig. 3b). The terrain here is similar to the first but only a few *Avicennia marina* trees provide cover. The soil here is a sandy loam with a gravelly surface.

Additional collections of crabs were made further north at Mida Creek, near Gede. A map and description of this area is given by Lumsden (1955).

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CRABS OBSERVED AT KILIFI CREEK

The most abundant supralittoral burrowing land crab at Kilifi Creek is *Sesarma meinerti* (Grapsidae) although the less common *Cardisoma carnifex* (Gecarcinidae) may often attract more attention because of its large size and striking violaceous color. The former measures up to 39 mm across the squarish carapace and displays bright red chelipeds. The rounded, heart-shaped carapace of the latter reaches breadths up to 87 mm and is overall dark purplish with the exception of the lighter purple chelipeds.

Just below the high tide zone (predominantly in the mid-littoral zone) two additional burrowing crabs are often in evidence but were not investigated. These are the fiddler crab, *Uca annulipes* (Ocypodidae), with a black-mottled white carapace and a pinkish major cheliped, and the smaller *Sesarma ortmanni* (Grapsidae) which is similar to *S. meinerti* in shape but is smaller and has orange chelipeds.

Cardisoma appears to be adapted to drier conditions than *Sesarma*. At both study sites on Kilifi Creek the former occupies a zone landward of the latter but overlapping seaward to a considerable extent. Apparently the highest tide line generally defines the lower boundary of *Cardisoma*. *Sesarma*, although occupying a lower zone, is probably flooded only during the highest tides. This is supported further by the mutual occurrence of *Avicennia* and *Sesarma*, the plant being normally adapted for occasional flooding.

The soil where *Cardisoma* burrows are found may become very dry during the dry season. All observations (February 2-4, 1968) were made during the later part of the dry season (November to March), and some burrows, well above the highest high tide area, were being actively maintained in essentially dry soil. Yet, in all occupied burrows excavated there was some free water in the bottom due to the crab's digging to depths sufficient to reach the water table.

The surface appearance of the burrows of *Cardisoma* and *Sesarma* is quite different (Fig. 2a). *Sesarma*, being the smaller, constructs narrow-mouthed burrows. The average diameter of the mouths of 25 burrows taken at random was 41 mm. The burrows of juvenile *Cardisoma* sometimes are confused with those of *Sesarma*, but frequently the latter are distinguishable by their tendency to be clumped and from the small (13 mm) round feeding casts found about the entrances. *Cardisoma* burrows can often be distinguished by the appearance of fecal pellets being rod shaped, and terminally truncate. *Cardisoma* burrows also often have a hood or cap of dried mud which is not noted for *Sesarma*. These hoods are always relatively small (Fig. 2a); the extensive "castles" reported by Silas and Sankarankutty (1960) were not seen.

Groups of *Sesarma* burrows characteristically occur under the protection of small *Avicennia* trees and thus are shaded during most of the day (Fig. 1b). The burrows of *Cardisoma* are situated more at random but many are associated with the trunks and roots of larger trees.



a



b

FIGURE 1. Kilifi Creek. a, Station 1. *Avicennia* thicket, habitat of *Cardisoma carnifex* and *Sesarma meinerti*. b, Burrows of *Sesarma meinerti* under cover of small *Avicennia* (Site 1).



a



b

FIGURE 2. a, Large hooded burrow of *Cardisoma* surrounded by smaller *Sesarma* burrows. Note spherical feeding casts by the latter (Site 1); b, Active non-hooded burrow of *Cardisoma* (Site 2). Note fresh mud mound at left (length of forceps 29 cm).



a



b

FIGURE 3. a, Adult *Cardisoma carnifex* at mouth of burrow associated with the roots of a large *Avicennia* (Site 1); b, Station 2. *Cardisoma* burrows indicated by arrows. Highest, high water line approximated by dashed line.

Six burrows of *Cardisoma* were excavated to determine their underground configuration. The results of these excavations are diagrammed in Figure 4. The burrows are simple, that is, with one mouth opening and no interconnections with other burrows or auxiliary tunnels or chambers. In some cases, a small appendix (usually just at ground level) may be present. This is in agreement with our findings for the burrows of other *Cardisoma* species in the New World and the observations by Bruce-Chwatt and Fitz-

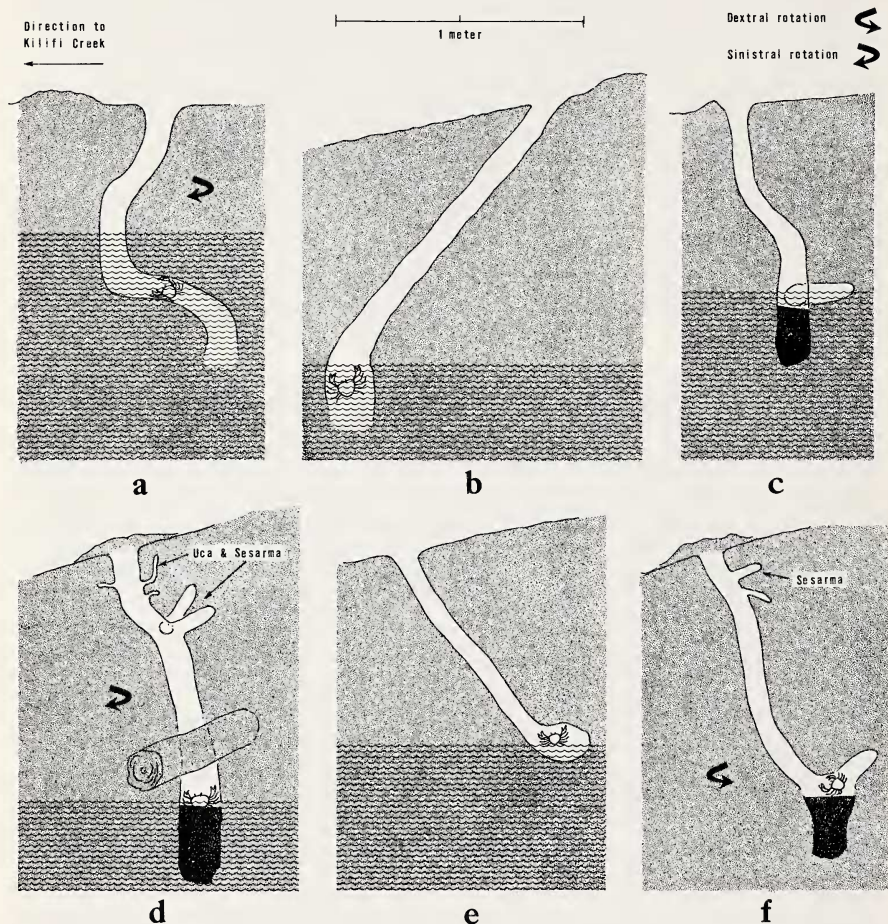


FIGURE 4. Diagrams representing configuration of six burrows of *Cardisoma carni-fex* excavated on north shore of Kilifi Creek at Station 2. Wavy lines represent level of water table (not available for f); dark tone approximates position of decomposing material when present; figure of crab indicates position where encountered during excavation.

John (1951) for *C. armata* on the west African coast. Occasionally the upper portion of the burrow throat will have numerous small side tunnels but these have always been found to represent the burrowing activities of other crabs, e.g., *Uca* and *Sesarma* (Fig. 4d).

Generally, the throat of the burrow slopes gradually (50 to 60 degrees) although in many cases the main axis of the shaft is practically perpendicular to the ground surface. Five of the six burrows excavated clearly possess an enlarged terminal chamber, three of which were filled at the bottom with an accumulation of silt and organic matter undergoing active decomposition as evidenced by its black color and sulphide odor. This feature is similar to other *Cardisoma* we have studied.

Only one *Sesarma* burrow was excavated. It was a simple vertical canal, approximately 1.3 meters deep, with a slightly enlarged terminal chamber. cursory examination of many additional *Sesarma* burrows with a flashlight and probe indicated that the above is typical.

ASSOCIATES

Two species of flies were found consistently dwelling in the burrows of both of these crabs: *Aedes* (*Skusea*) *pembaensis* Theobald, 1901 (Culicidae) and *Psychoda martini* Hogue, 1970 (Psychodidae).

The mosquito *Aedes* (*Skusea*) *pembaensis* thrives in large numbers in association with both crabs. Formerly only the burrows of *Sesarma* were recorded as hosting this species (Heisch et al. 1956; Brooke Worth et al. 1961 for *S. meinerti*; Lumsden 1955:171 for *S. eulimene*—misidentification ? = *ortmanni*). Adult mosquitoes commonly rest on the walls of the burrow and emerge readily to bite. Larvae and pupae often occur in dense numbers in the water which fills the terminal chambers of all burrows. The eggs of this mosquito have been found on the legs of *S. meinerti* by Goiny et al. (1957); however, no specimens of this crab collected during the study carried mosquito eggs. On the other hand almost all of the *C. carnifex* were positive for eggs, the latter being found or concentrated in large numbers along certain portions of the anterior parts of the carapace and on the mouth parts. Specifically the following surfaces are utilized by the mosquitoes as oviposition sites (Fig. 5): 1) upper one-half of eye socket; 2) outer surface of exopodite of eye and rarely on eye stalk itself; 3) triangular area at the base of the orbital region; 4) epistomal region; 5) dorso-lateral surface of buccal cavity; 6) outer and inner surfaces of palps and meri of 3rd maxillipeds.

This species of mosquito has been incriminated in the transmission of filariasis and may be involved in the dissemination of pathogenic viruses (Heisch et al., 1957). Mosquito surveys for public health purposes should definitely take into account its existence in crabholes and this breeding site should not be overlooked as an important source of large numbers of this potentially dangerous mosquito.

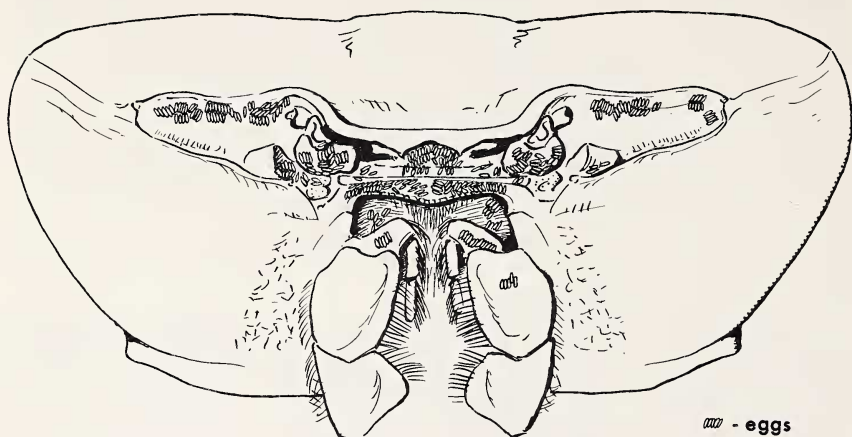


FIGURE 5. Anterior view of carapace of *Cardisoma carnifex* showing eggs of *Aedes pemaensis* in areas typically used as oviposition sites by the females. Eyes omitted.

A lengthy series of a moth fly (family Psychodidae) of the genus *Psychoda* was also collected from the burrows of both crabs. It has proven to be an undiscovered species and has been named and described by Hogue, 1970, *Psychoda martini*. Only adult flies were in evidence at the collection site resting and moving over the burrow walls. No early stages were found in the numerous water samples.

LAND CRAB RECORDS

The following general accounts are given for the four species of crabs collected during this study to establish their occurrence and facilitate their recognition by future workers.

Cardisoma carnifex (Herbst, 1794)

DISTRIBUTION: Mauritius, Madagascar, Andaman Islands, east coast of Africa, and whole of Indo-Pacific. For much of their range they occur in sympatry with *C. hirtipes* Dana (see Miyake, 1939, for a key to these two species).

LOCALITY: Kilifi Creek.

HABITAT: Common inhabitants of muddy shores, mangrove swamps and of saline lowland soils near the coast.

ECOLOGY: Constructs well-defined burrows in soft soils where there is available ground water during the dry season. Females repair to the sea to introduce the prezoaea to the required sea water environment.

COLOR: Carapace dark purple; chelipeds light purple to dark cream.

REFERENCES: Barnard, 1950; Macnae, 1963; and Miyake, 1939.

Sesarma (Sesarma) meinerti de Man, 1887

DISTRIBUTION: Andamans and Madras, Mozambique, Mauritius, Madagascar; east coast of Africa (south to Port St. John's), Australia, and Indo-Pacific.

LOCALITIES: Kilifi Creek, Mida Creek.

HABITAT: Sandy-clay areas and muddy banks from upper mid-littoral to the lower limits of the supralittoral. Generally associated with mangroves, e.g., *Avicennia*, but in upper dryer areas of mangroves also associated with *Juncus kraussii* and *Fimbristylis abbreviata*.

ECOLOGY: Burrows most common in areas with hard, baked mud. A few burrows have been observed with hoods. Crabs are generally nocturnal, remaining well within the burrow during the day.

COLOR: Carapace black to grey; chelipeds bright red.

REFERENCES: Chace, 1942; Day, Millard and Broekhuysen, 1954; and Macnae and Kalk, 1969.

Uca annulipes (Latreille, 1820)

DISTRIBUTION: East coast of Africa to Indo-Pacific (as far east as the Mariana and Caroline Islands).

LOCALITIES: Kilifi Creek, Mida Creek.

HABITAT: Mud flats and clay-sandy areas in and adjacent to tropical and subtropical estuaries and mangroves.

ECOLOGY: Constructs colonial, intersecting burrows among *Avicennia* roots, and on open areas between the mangroves. Not reported living within the mangroves proper. Known to migrate long distances (several hundred feet) from the burrows to feed. Females are very inconspicuous and seldom seen out during the day.

COLOR: Carapace grayish, chelipeds salmon pink.

REFERENCES: Alcock, 1900; Chace, 1942; Macnae and Kalk, 1969; and Miyake, 1939.

Note: This is still often listed as *Gelasimus annulipes*.

Sesarma (Holometopus) ortmanni Crosnier, 1965

DISTRIBUTION: East coast of Africa, Madagascar.

LOCALITIES: Mida Creek, Kilifi Creek.

HABITAT: Muddy soils in mangroves.

ECOLOGY: Constructs shallow burrows among exposed pneumatophores of *Avicennia*.

COLOR: Carapace greenish brown; claws dull orange.

REFERENCES: Crosnier, 1965; and Macnae and Kalk, 1969.

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